MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

TCI3121 – COMPUTATIONAL INTELLIGENCE

(All Sections/Groups)

27 OCTOBER 2017
09:00AM – 11:00AM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 3 pages (including cover page) with 4 structured questions.
2. Answer ALL questions. The distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

Question 1

(a) The Turing test, developed by Alan Turing in 1950, is a test of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human. Briefly describe how machine's intelligence is tested using Turing Test.

(2 marks)

(b) Suppose we want to teach a neural network to recognize the first four letters of the alphabet on a 5×7 grid, as shown in Figure 1. Assume that the input to the neural network is based on the raw pixels.

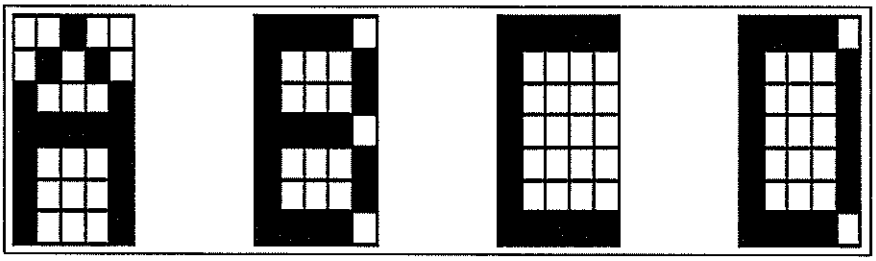

Figure 1

i. Briefly describe the correct way to train the neural network. (3 marks)
ii. How many input neurons are needed for this neural network? (1 mark)
iii. How many output neurons are needed for this neural network? (1 mark)

(c) In 1975, John Holland introduces Genetic Algorithm; an algorithm based on the mechanism of natural adaptation and evolution. Genetic algorithms are commonly used to generate high-quality solutions to optimization and search problems by relying on bio-inspired operators such as *selection*, *crossover*, and *mutation*. Explain and illustrate *selection*, *crossover*, and *mutation* in Genetic Algorithm. (3 marks)

Question 2

(a) A fuzzy membership function is a curve that defines how each point in the universe of discourse is mapped to a membership value (or degree of membership) between 0 and 1.

i. How are the fuzzy membership functions found? (2 marks)
ii. Illustrate two different membership functions for the fuzzy set {**"number about 5"**} (2 marks)

(b) Mamdani's fuzzy inference method is the most commonly seen fuzzy methodology. Mamdani's method was among the first control systems built using fuzzy set theory.

i. Illustrate a two input, two rules Mamdani's fuzzy inference method. (3 marks)
ii. List the six steps of Mamdani's fuzzy inference method. (3 marks)

Continued.....

Question 3

Given the following training samples (*p0*, *p1*, *p2*, *p3*), with the bias *in_0*, two inputs (*in_1* and *in_2*), and target output *d*. The initial weight vector *W0* is set to (1, 1, -1), and the learning rate *lr* is equal to 1.

Training Samples

	in_0	*in_1*	*in_2*	*d*
p0	1	-1	-1	-1
p1	1	-1	1	-1
p2	1	1	-1	1
p3	1	1	1	-1

Suppose sign activation function and perceptron learning are used:
(a) Draw the network architecture. (2 marks)
(b) Compute the final weights after one epoch. (8 marks)

Question 4

(a) Using your own intuition and definition of the universe of discourse, list the linguistic variables of the fuzzy membership function for *"temperature of air conditioner"*.
(2 marks)

(b) Construct the linguistic variable in (a) using triangular membership function.
(2 marks)

(c) Consider $R_1 \in X \times Y = \begin{bmatrix} 0.9 & 0.2 & 0.5 \\ 0.7 & 1 & 0.6 \\ 0.8 & 0.3 & 0.4 \end{bmatrix}$ and $R_2 \in Y \times Z = \begin{bmatrix} 0.5 & 0.8 \\ 0.1 & 0.6 \\ 0.9 & 0.3 \end{bmatrix}$. Compute the Max-Min composition of $R_1 \circ R_2$.
(6 marks)

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